

Exploring Meteorite Mysteries

Meteorite ABC's Fact Sheet

Major Minerals in Meteorites

Listed are the major minerals in meteorites, their composition and occurrence. Minerals are listed by group: silicates, metal, sulfides, oxides, phosphates, and carbon compounds. Many other minerals occur in small abundances but are not listed. Mineral compositions in meteorites and other rocks are variable, with similar elements substituting for each other in the crystal structure (for example Mg, Fe, Ca in silicates or Mg, Fe, Cr, Al in oxides). Variations in these mineral compositions are important in meteorite classification.

Mineral	Formula or Composition	Occurrence in Meteorites
Silicates olivine pyroxene feldspar clay minerals	(Mg,Fe)Si ₂ O ₄ (Mg,Fe,Ca)SiO ₃ CaAl ₂ Si ₂ O ₈ .NaAlSi ₃ O ₈ (Mg,Fe,Ca) ₃₋₆ Si ₄ O ₁₀ (OH) ₂ *H ₂ O	stony and stony-irons chondrites, stony-irons chondrites, achondrites, stony-irons most abundant in achondrites mostly in carbonaceous chondrites
Metal kamacite, taenite	Fe (low and high Ni)	abundant in irons, stony irons common in most chondrites
Sulfides troilite, pyrrhotite	FeS, Fe ₇ S ₈	abundant in irons, stony irons minor in stony meteorites
Oxides spinel, magnetite, chromite	(Mg,Fe,Cr,Al) ₃ O ₄	minor in most meteorites composition depends on type
Phosphates apatite, whitlockite	Ca ₅ (F,Cl,OH)(PO ₄) ₃ , Ca ₂ PO ₄	minor in stony meteorites
Carbon compounds diamond, graphite organic molecules, amino acids	C (elemental carbon) C,H,O,N compounds	carbonaceous chondrites carbonaceous chondrites

Meteorite Classifications

Listed are the major types and classes of meteorites, with examples of each. Major types are in **bold** and most abundant classes are in *italics*. Minor classes are in normal font and only those discussed in text are listed. Other sometimes more abundant classes are omitted for simplicity.

Type / Class	Mineralogy / Rock Types	Examples
Stony - chondrites <i>ordinary chondrites</i> carbonaceous chondrites	silicate minerals, chondrules varied iron, metamorphism varied metamorphism, weathering	Noblesville, LEW87030, ALH90411 Allende, ALH83100
Stony - achondrites <i>basaltic achondrites</i> planetary- lunar - martian	silicate minerals, no chondrules basalt, breccia, pyroxene cumulate basalt, anorthosite, breccia basalt, pyroxene-olivine cumulate	Juvinas, Johnstown, EET83227 ALHA81005, EET87521 EETA79001, Shergotty
Stony-irons	metal-silicate cumulate, breccia	Brenham, Estherville
Irons	iron-nickel metal intergrowths	Sikhote Alin, Gibeon

Meteorites in Meteorite Sample Disk

Name	Location	Find date	mass (kg)	classification
ALH90411	Allan Hills, Antarctica	1990	5.8	chondrite L3
LEW87030	Lewis Cliff, Antarctica	1987	8.0	chondrite H5
Allende	Allende, Mexico	1969	1,000	carbonaceous chondrite
EET83227	Elephant Moraine, Ant.	1983	2.0	basaltic achondrite
Gibeon	Namibia, Africa	1836	21,000	Iron - octahedrite
Brenham	Kansas, USA	1882	4400	Stony-iron - pallasite

Descriptions of Meteorites in Meteorite Sample Disk

ALH90411 (Chondrite A) This ordinary chondrite has numerous clasts and chondrules in a light gray matrix. It is a low-iron, non-metamorphic chondrite made up mostly of olivine and pyroxene silicate minerals, with a little iron-nickel metal.

LEW87030 (Chondrite B) This ordinary chondrite has abundant metal and few clasts or chondrules in a dark gray matrix. It is a high-iron, metamorphic chondrite made up of olivine and pyroxene silicate minerals and iron-nickel metal.

Allende (Carbonaceous Chondrite) This carbonaceous chondrite is a dull black sample with visible clasts and chondrules in hand specimen. A thin slice shows numerous small white inclusions and chondrules in a dark carbonaceous matrix.

EET83227 (Achondrite) This basaltic achondrite is a rock made up of fragments of various types of basaltic materials in a fine-grained matrix. A thin slice shows fragments of different types of pyroxene-feldspar basalts and mineral fragments in a matrix of the same minerals.

Gibeon (Iron) This iron meteorite has a fine-grained intergrown of kamacite and taenite iron-nickel minerals. This criss-crossed intergrowth is called Widmanstätten texture and is visible on the sawn surface that has been etched with acid.

Brenham (Stony-iron) This stony-iron meteorite is a cumulate consisting of yellow olivine silicate crystals surrounded by iron-nickel metal. The metal has been polished and would show a Widmanstätten texture if it were etched with acid.

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